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A CHAPTER IN THE DEVELOPMENT OF ARITHMETIC TEACHING IN THE UNITED STATES

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In considering methods of teaching a subject it is often profitable to investigate the methods which have been used in the teaching of this subject in the past. This is especially true of a subject, such as arithmetic, which has been taught since the time of the earliest schools without material change in content. In the case of arithmetic, a retrospective study of methodology is particularly illuminating, because the earliest method of instruction seems to have been considered efficient for a long period, there being practically no change until about 1825. The object of this paper is to give a notion of the arithmetic teaching in the schools of the latter part of the eighteenth and the beginning of the nineteenth century and to attempt an analysis of the method of instruction.

We have practically no record of the method of teaching arithmetic before the close of the Revolution, but several things lead us to believe that few changes were made in the method of teaching during the eighteenth century. We may then think of the schools of about 1800 as being typical, in respect to the teaching of arithmetic, of the schools of the eighteenth century. Concerning these schools we have the testimony of men who attended them.

It appears that in these schools arithmetic texts were seldom found in the hands of the pupils and it was unusual for the teacher to possess one. It is stated that many pupils never even saw an arithmetic. The master dictated or set "sums," as the problems were called, and the pupils worked them on scraps of paper. The teacher told the pupil the rule, and when the pupil had finished his "sum" he took it up to the teacher for approval, or disapproval. Often the teacher was surrounded by pupils waiting their turn.

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[1] This article concludes the series begun in May and continued in June in the *Elementary School Teacher*.

As a rule each pupil had a blankbook made of a quire of paper folded and sewed together. This was his "Cyphering Book." After his work was approved by the master, the pupil carefully copied in his "Cyphering Book" the problem and its solution, together with the rule which the master had given him. The master usually possessed such a "Cyphering Book" which he had made as a pupil under his master and which now served as his source of "sums" and rules. It was also his criterion of correct answers and methods.

In Barnard's *Journal of American Education* we find a number of articles written by men who attended school about 1800. Some of their experiences seem to be so typical of the method of teaching arithmetic that we quote from them at some length.

". . . . At length, in 1790 or 1791, it was thought I was old enough to learn to *cypher*, and accordingly was permitted to go to school more constantly. I told the Master I wanted to learn to cypher. He set me a *sum* in simple addition—*five columns* of figures, and *six figures* in each column. All the instruction he gave me was—add the figures of the first column, carry one for every ten, and set the over-plus down under the column. I supposed he meant by the *first* column the left-hand column; but what he meant by carrying one for every ten was as much a mystery as Samson's riddle was to the Philistines. I worried my brains an hour or two, and showed the master the figures I made. You may judge what the amount was, when the columns were added from left to right. The master frowned and repeated his former instruction—add up the column *on the right*, carry one for every ten, and set down the remainder. Two or three afternoons (I did not go to school in the morning) were spent in this way, when I begged to be excused from learning to cypher, and the old gentleman with whom I lived thought it was time wasted; . . . . The next winter there was a teacher more communicative and better fitted for his place, and under him some progress was made in arithmetic, and I made a tolerable acquisition in the first four rules, according to Dilworth's *Schoolmaster's Assistant*, of which the teacher and one of the eldest boys had each a copy. The two following winters, 1794 and 1795, I mastered all the rules and examples in the first part of Dilworth; that is, through the various chapters of Rule of Three, Practice, Fellowship, Interest, etc., etc., to Geometrical Progression and Permutation."[1]

". . . . Printed arithmetics were not used in the Boston schools till after the writer left them, and the custom was for the master to write a problem or two in the manuscript of the pupil every other day. No boy was allowed to cypher till he was eleven years old, and writing and ciphering were never performed on the same day. Master Tileston had been taught by Master Proctor, and all the sums he set for his pupils were copied exactly from his old manuscript. Any boy could copy the work from the manuscript of any further advanced than himself, and the writer never heard any explanation of any principle of arithmetic while he was at school. Indeed, the pupils believed that the master could not do the sums he set for them, and a story is told of the good old gentleman, which may not be true, but which is so characteristic as to afford a very just idea of the course of instruction, as well as of the simplicity of the superannuated pedagogue. It is said that a boy, who had done the sum set for him by Master Tileston, carried it up, as usual, for examination. The old gentleman, as usual, took out his manuscript, compared the slate with it, and pronounced it wrong. The boy went to his seat and reviewed his work, but finding no error in it returned to the desk and asked Mr. Tileston to be good enough to examine the work, for he could find no error in it. This was too much to require of him. He growled, as his habit when displeased, but he compared the sum again, and at last, with a triumphant smile, exclaimed, "See here, you *nurly* (gnarly) wretch, you have got it, 'If four tons of hay cost so much, what will seven tons cost?' when it should be, 'If four tons of *English* hay cost so and so.' Now go and do it all over again."[1]

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[1] Joseph T. Buckingham, *Barnard's Journal*, XIII, 130.

As has been pointed out, arithmetic texts were scarcely used in the schools. To us this is probably the most conspicuous factor of this early teaching. This practice was probably due in the beginning to the fact that sufficient texts were not available to do otherwise.[2] But the continuance of a method of instruction which did not make use of a text cannot be due to texts not being available during the eighteenth century. Several texts by English authors were known in the colonies in the early part of the eighteenth century and by 1800 there had been at least fifteen arithmetic texts published by American authors.

Edmond Wingate published an *Artificial Arithmetic* in 1629. The fifteenth edition was published in 1726[3] and another edition in 1753.[4] Littlefield states: "A copy of the first edition is now in existence which was used in the Winslow family of Massachusetts for over one hundred years."[5]

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[1] Wm. B. Fowle, *Barnard's Journal*, V, 336.

[2] There is evidence that arithmetic was taught in the colonies as early as 1665 and possibly as early as 1658. Suitable arithmetics were not known to any extent in the colonies until after 1700.

[3] A copy of this edition is in the Library of the University of Chicago.

[4] G. E. Littlefield, *Early New England Schools*, 163.

[5] *Ibid.*, 163.

Hodder's Arithmetic: or that Necessary Art made most easy, by James Hodder, writing master, was published in 1661. The twenty-fifth edition was printed in Boston in 1719.[1]

Cocker's *Vulgar Arithmetic, by Edward Cocker,* "Late Practitioner in the arts of Writing, Arithmetic and Engraving" was published in 1677. An edition of Cocker's *Arithmetic* was published in Philadelphia in 1779. It has been said that Cocker's *Arithmetic* "may be considered the father of modern arithmetics, as it furnished the plan which all of them have copied."

The Schoolmaster's Assistant, by Thomas Dilworth, was first published in 1743. It was republished in Philadelphia in 1769. I have a copy published in Philadelphia in 1790. The twenty-third edition was printed in Hartford in 1786; also an edition was printed in Wilmington in 1796, and one in New York in 1797. At the time of the Revolution and after until about 1800 it was more extensively used in this country than any other text.

That these texts did not become generally used in the schools and the method of instruction correspondingly changed seems to have been mainly due to a belief in the efficiency of the method of teaching arithmetic without a text.

To be sure, books were more expensive then than now, if we take into account the purchasing value of money. But this condition does not seem to have prevented the printing and distribution of religious writings and the almost universal use of the Psalter and Catechism in the schools. And certainly in the study of Latin, texts must have been used. "A printing press was set up at Cambridge (Massachusetts) as early as 1639, but it was wholly engaged in turning out controversial pamphlets of a religious nature."[2]

Another reason for believing that the efficiency of the "Cyphering Book" seems to have been accepted is that the first arithmetic published by an American author was a specific attempt to further the "Cyphering Book" method. Isaac Greenwood wrote *Arithmetic, Vulgar and Decimal: with the application thereof, to a variety*

[1] *Ibid.*, 167.

[2] Dexter, *History of Education in the United States,* 207.

of Cases in Trade, and Commerce,[1] which was published in 1729. He states what appears his chief purpose as follows:

> "The Reader will observe, that the author has inserted under all those rules, where it was proper, Examples with Blanks for his practice. This was a principal End to the Undertaking; that such persons as were desirous thereof might have a comprehensive Collection of all the best Rules in the Art of Numbring, with examples wrought by themselves. And that nothing might be wanting to favour this design, the Impression is made upon several of the best Sorts of Paper. This Method is entirely new, ... "
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> The paper used in the book is thick, the type large. Words and phrases to which the author desires to call special attention are printed in italic characters, and, as more than half the book is, in the author's eyes, important, more than half is printed in italics. The method followed by the author seems to be in most cases to give the rule in each subject, then examples illustrating the rule, then examples for the student, and finally the proof. There is very little explanation aside from the rule. Each example has a "blank" beneath it for the student's "practice." There are no collections of examples, as in modern books. At times, though not always, terms, such as annuity, interest, etc., are explained.[2]

Greenwood's text seems to have not been well received and was used very little in the schools.[3] However, this same feature was utilized by Daniel Adams, who wrote *The Scholar's Arithmetic,* first published in 1801. In the preface of a revised edition, dated December 26, 1815, Mr. Adams writes as follows:

> We have now the testimony of many respectable Teachers to believe, that this work, where it has been introduced into Schools, has proved a very kind assistant towards a more speedy and thorough improvement of Scholars

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[1] J. M. Greenwood, "Notes on the History of American Textbooks on Arithmetic," *Report of Commissioner of Education for 1897-98,* 802. "There are two copies of this book in Harvard College library and one in the Library of Congress."

[2] *Ibid.,* 805.

[3] The second text by an American author was *A New and Complete System of Arithmetic, composed for the use of the citizens of the United States,* by Nicholas Pike in 1788. This is nearly sixty years after the appearance of Greenwood's text and apparently by this time the work of Greenwood was forgotten.

Pike says in the dedication of his text, "As this work is the first of the kind composed in America. . . . ." George Washington in his recommendation of Pike's book mentions that it is the first of its kind. That Pike did not know of Greenwood's book would seem to indicate that it made little impression and was soon forgotten, because Greenwood was professor of mathematics in Harvard College at the time he published his text and Pike graduated from Harvard.

> in Numbers, and at the same time, has relieved masters of a heavy burden of writing out Rules and Questions, under which they have no long labored, to the manifest neglect of other parts of their schools.
>
> To answer the several intentions of this work, it will be necessary that it should be put into the hands of every Arithmetician: the blank after each example is designed for the operation by the scholar, which being first wrought upon a slate, or waste paper, he may afterwards transcribe into his book.

This text apparently attained some popularity, for by 1815 it had gone through nine editions. I have seen a copy printed as late as 1824. I have a copy printed in 1820 which bears the imprint of the hand of some pupil who doubtless labored long over the involved and obscure problems.

Although we do not find other texts of this period making this specific provision for the "Cyphering Book" method, yet they were such that they contributed to this method of instruction. For the most part the texts were simply collections of rules and problems. Only occasionally do we find any attempt to explain or develop the rules and often the rules are not even illustrated by solving an example. Rules are given for every case. A set of rules are given for the Rule of Three with integers, another set is given for vulgar fractions, and still a third set for decimal fractions. Speaking of Dilworth's *Schoolmaster's Assistant*, Cajori says: "The whole book is nothing but a Pandora's box of disconnected rules. It appeals to memory exclusively and completely ignores the existence of reasoning powers in the mind of the learner."[1] (Dilworth's text was the most widely used book at the time of the Revolution and after to 1800.)

Such texts could serve for little more than a source of rules and problems. The extreme to which pupils and teacher alike depended upon the "rule" is shown by the following:

> I quote the following from an article "Early School Days" in Indiana, contributed by Barnabas C. Hobbs. A law had just been passed requiring that teacher's examinations should be conducted by three county commissioners instead of the township trustees, as had been the practice before. "I shall not forget," says Hobbs, "my first experience under the new system. The only question asked me at my first examination was, 'What is the product

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[1] F. Cajori, "The Teaching and History of Mathematics in the United States," *Circular of Information No. 3*, 1890.

of 25 cents by 25 cents?' We were not as exact then as people are now. We had only Pike's *Arithmetic*, which gave the sums and the rules. These were considered enough at that day. How could I tell the product of 25 cents by 25 cents, when such a problem could not be found in the book? The examiner thought it was 6¼ cents, but was not sure. I thought just as he did, but this looked too small to both of us. We discussed its merits for an hour or more, when he decided that he was sure I was qualified to teach school, and a first-class certificate was given me."[1]

We may appropriately characterize the arithmetic instruction up until about the close of the first quarter of the nineteenth century as the "Cyphering Book" method. Even though texts were used toward the close of this period, it seems that many of the essential features of the method were retained. The method persisted in some localities until well into the nineteenth century. Even today one occasionally finds a teacher who instructs his class without a text in the hands of the pupils. We retain certain features of the method when we require pupils to keep a notebook in which they record their work.

However, this is not the only phase of the method which seems worth considering. The instruction was largely individual. Each pupil worked on a problem of his own. When he had completed his work he took it to the teacher, and if he had not solved his problem, or had met with a difficulty, received individual attention.

The instructions given by the teacher were for his own benefit. Since there was no class instruction, there was no reason why the pupils should be kept together. If some pupils progressed less rapidly than the others, they did not hinder the work of those who were able to work more rapidly, and they in turn were not handicapped by being behind the class.

The writer does not wish to be understood as advocating the method of a hundred years ago as an efficient one for teaching arithmetic. An attempt to follow it under present conditions would most probably result in failure. And it must be admitted that for many of the practices of the teachers of this period we can present no justification. But it seems that what we have called the "Cyphering Book" method contains some features which are worthy of consideration.

[1] *Ibid.*, 16.

Toward the end of the first quarter of the nineteenth century the teachings of Pestalozzi began to receive attention in this country. We find his method of oral instruction incorporated in a text by Warren Colburn which was published in 1821. This text was adopted almost immediately by the schools and with its introduction we find the first marked change in the method of teaching. The decline of the "Cyphering Book" method accompanied the introduction of a new method.